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ABSTRACT

A study investigated the influence of key factors (general comprehension ability, prior knowledge of passage topic, interest in passage topic, and locus of control) on training at-risk college students in the use of graphic organizers as a cognitive learning strategy. Subjects, 60 college freshmen required to take a developmental reading/study skills course, were tested for prior knowledge on several topics, given an interest rating questionnaire and randomly assigned to an experimental or control group. Subjects assigned to the experimental group were trained to read passages consisting of scientific expository text with a comparison-contrast internal organization; annotate the passages and identify and organize comparison/contrast information; use telegraphic writing to complete a graphic organizer; and incorporate the comparisons and contrasts into a summary statement. The control group carried out several comprehension development activities that did not deal with text structures. Posttests for both groups consisted of reading a scientific passage, annotating it, completing a graphic organizer of the passage, and completing an immediate retention multiple choice test. Results indicated that: (1) training in recognition of expository text structure was successful in improving students' ability as measured by the graphic organizer task; (2) improvement due to training was found only for the poorer readers; and (3) instruction did little to improve students' summarizing scores or passage comprehension. Findings suggest that in-depth training in graphic organizers may be superfluous for the average college student. (Two tables and 4 figures of data are included; 21 references, the posttest passage, and a sample student graphic organizer are attached.) (RS)

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Effects of Reading Ability, Prior Knowledge, Topic Interest, and Locus of Control on At-Risk College Students' Use of Graphic Organizers and Summarizing

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Widely heralded as an effective cognitive learning strategy, the use of graphic organizers has received very little empirical examination. The bulk of the literature on graphic organizers has been descriptive in nature, categorizing the various kinds of graphic organizers or describing curricular projects involving the teaching of graphic organizers (e.g., Holly & Dansereau, 1984; Pehrsson & Robinson, 1985).

The few empirical research studies on graphic organizers carried out to date have supported their use. Training in graphic organizers can improve comprehension (Berkowitz, 1986; Guri-Rozenblitt, 1989; Weisberg & Balajthy, in press). When graphic organizers are taught in conjunction with summarizing training, quality of student summarizing can improve (Balajthy & Weisberg, in press; Ruddell & Boyle, 1989; Weisberg & Balajthy, 1989). Use of graphic organizers also improves students' ability to recognize text structure (Balajthy & Weisberg, in press; Weisberg & Balajthy, 1989), a critical factor in comprehension improvement (Meyer, 1982).

The present study investigated the influence of key factors on training at-risk college students in use of graphic organizers as a

cognitive learning strategy. These factors included general comprehension ability, prior knowledge of passage topic, interest in passage topic, and locus of control. Prior knowledge of passage topic has been recognized as an important contribution to comprehension both in schema-comprehension research (Anderson & Pearson, 1984), as well as in research specifically with graphic organizers as a cognitive learning strategy (Balajthy & Weisberg, in press). Similarly, topic interest has been identified as contributing to comprehension independently of prior knowledge (Baldwin, Peleg-Bruckner, & McClintock, 1985; Head, Readence, & Buss, 1989).

The present study also included locus of control as a variable. Locus of control has been identified as a problematic issue especially with multicultural students (Dyal, 1984; Gaa, Williams, & Johnson, 1981), as were the majority of subjects in this study.

METHOD

Subjects

Subjects were a college freshman populatin (n = 60) required to take a developmental reading/study skills course. Most students enrolled in the course had been admitted to college under the Educational Opportunity Program, on the basis of low high school performance and economic need. Many students in the developmental course at this particular college were of higher ability than students in typical developmental reading/study skills courses, due to relatively high admissions standards for the college.

Subjects were randomly assigned to an experimental or control group. The mean score on the comprehension subtest of the Stanford Diagnostic Reading Test (Karlsen, Gardner, & Madden, 1984) for the experimental group was 49.98 and for the control group 51.53.

Procedures

Pretest. Prior to training, all subjects were administered a true-false test of prior knowledge on several topics, including the topic of the posttest passage. Ten questions were included for each topic. In addition, all subjects were given an interest rating questionaire to determine their interest in a variety of topics, including the posttest passage topic.

Training. Instruction was carried out using a collection of eight readings consisting of scientific expository text, each of which had a comparison-contrast internal organization. Students in the experimental group were trained by one of the researchers to: (a) Read the passage to identify topics and categories of comparisons; (b) Annotate the passage to identify and organize comparison/contrast information; (c) Use telegraphic writing to complete a graphic organizer (see Appendix B for an example of a student's graphic organizer); and (d) Incorporate the comparisons and contrasts into a summary statement. Training was similar to that described in more detail elsewhere (Balajthy & Weisberg, in press; Weisberg & Balajthy, 1989).

Instruction included explicit rules and modeling for constructing graphic organizers and writing summaries. Experimental subjects

received four training sessions of 40 minutes each over a 2-week period, as well as homework assignments for three of the sessions. Instruction and practice totaled about 10 hours. In each training session, students worked in cooperative learning groups to read a passage, construct a graphic organizer, and write a summary. Feedback on performance was then provided by the instructor.

The control group carried out several comprehension development activities that did not deal with text structure. They did, however, receive a short, one-half hour presentation that introduced them to graphic organizers so they could complete the posttest.

Posttest. Both groups were administered a posttest consisting of one passage. The topic was "Scientific Mixtures," and the passage had a comparison-contrast text structure. Subjects were instructed to read and annotate the passage. They then constructed a graphic organizer and a summary. Finally, they completed an immediate retention multiple choice test of 10 items. The questions were created by the researchers and verified for passage dependency by them and by the classroom instructors.

Scoring. A master template of the text structure of the passage was created by the researchers. The text was parsed into idea units and a grid of the comparisons and contrasts within the passage was created. Subjects' posttest graphic organizers and their summaries were scored against this master template. Each score was the percentage of items on the template that had been included. Both graphic organizers and summaries were scored by two persons (the researchers or their assistants), then minor differences were resolved in discussion.

RESULTS

Overall Performance on Dependent Measures

All subjects combined scored a mean of 52.28% on their graphic organizer scores, 30.29% on their summarizing scores, and 69.17% on their passage comprehension scores. Clearly their ability to summarize, a complex ability relating not only to comprehension but also to writing skills, was much lower than their ability to recognize structure of ideas in text or their ability to perform on a multiple choice recall instrument.

Between-Group Performance on Dependent Measures

Mean results by group are listed in Table 1. In order to examine differences due to training, three separate univariate ANOVAs were performed, one for each of the three dependent variables. The between-subjects factor for each analysis was group.

Place Table 1 About Here

The ANOVA for graphic organizers indicated a statistically significant difference in favor of the experimental group, $F(1, 58)=9.78, p<.003$. The ANOVA for summarizing did not indicate a significant between-group difference, nor did the ANOVA for passage comprehension.

These results suggest that, on an overall basis, the extensive training in use of graphic organizers and summarizing did not improve passage comprehension, as measured by a multiple choice test, nor did it

improve summarizing skills.

Correlations by Group

In an effort to look more closely at the factors involved in the performance of the two groups, Pearson product-moment correlations were computed for each of the three dependent measures, graphic organizers, summarizing, and passage comprehension. Other factors included in the correlation matrix were general comprehension ability, locus of control, topic interest, and prior knowledge of the topic.

For Group 1, the only significant correlations were among the dependent measures. Graphic organizer scores correlated with both summarizing ($r = .60$, $p < .001$) and with passage comprehension ($r = .43$, $p < .02$). Summarizing correlated with passage comprehension, ($r = .40$, $p < .04$). No statistically significant correlations were indicated involving general comprehension ability, locus of control, topic interest, or prior knowledge of topic.

For Group 2, general comprehension ability was significantly

correlated with all three dependent measures, graphic organizers (r = .55, p < .002), summarizing (r = .49, p < .006), and passage comprehension (r = .43, p < .02). The only other relevant significant correlation was graphic organizer score with summarizing, (r = .41, p < .03).

Regressions by Group

Three multiple regressions were carried out for each group, using the three dependent variables as criterion variables. There were four predictor variables for each of the analyses, comprehension, locus of control, prior knowledge of topic, and topic interest.

For the graphic organizer criterion variable, the Group 1 analysis indicated that 16% of the variance was explained by the model, $F(1,24)$ = 4.70, p < .05. Only locus of control was statistically significant as a predictor. The Group 2 analysis indicated that 33% of the variance was explained by the model, $F(1,29)$ = 12.32, p < .002. Only comprehension was statistically signficant as a predictor.

For the summarizing criterion variable, the Group 1 analysis

indicated that only 10% of the variance was explained by the model and no predictors were statistically significant. The Group 2 analysis indicated that 24% of the variance was explained by the model, $F(1,29) = 9.18$, $p < .006$. Only comprehension was statistically significant as a predictor.

For the passage comprehension criterion variable, the Group 1 analysis indicated that 22% of the variance was explained by the model, and no predictors were statistically significant. The Group 2 analysis indicated that 18% of the variance was explained by the model, $F(1,29) = 6.46$, $p < .02$. Only comprehension was statistically significant as a predictor.

It was apparent that general comprehension ability played an important role in the control group's results, but not in the results of the experimental group. It may be that the training in graphic organizers removed general comprehension ability as a critical factor on the criterion tasks for this passage. If graphic organizers do indeed play such a role, their usefulness for poorer readers, whose academic efforts are usually severely hampered by their low general comprehension ability, may be great.

Analysis of Top and Bottom Quartiles

In order to more carefully examine the role of ability in the application of cognitive learning strategies, subjects in the upper and lower quartiles, as determined by scores on the Comprehension Subtest of the Stanford Diagnostic Reading Test (Karlsen, Gardner, & Madden, 1984), were identified. The mean comprehension score of the highest quartile was 56.27, corresponding to a grade equivalent score of post-high school. The mean comprehension score of the lowest quartile was 43.21, corresponding to a grade equivalent score of 7.3. The results of the lower quartile were of particular interest, as that group was more representative of the type of underprepared college students typically found in college level developmental reading courses. Mean scores broken down by both ability and training are reported in Table 2.

Place Table 2 About Here

Four separate analyses of variance were carried out for each quartile group, with training as the between-subjects variable in each analysis, and with total score (a combination of the three subscores), graphic organizer, summary, and passage comprehension as the four dependent variables. The researchers believed the analyses to be important, despite limitations imposed on the analyses by the very small group sizes.

For the high quartile group, no significant findings were indicated in any of the analyses. For the low quartile group, significant differences in favor of the experimental group were indicated for both the total score, $F(1,12) = 4.56$, $p < .05$ (see Figure 1) and for the graphic organizer score, $F(1,12) = 6.66$, $p < .03$ (see Figure 2). While differences were not statistically significant for either summarizing (see Figure 3) or for passage comprehension (see Figure 4), the training group did obtain numerically higher scores in each.

Place Figures 1, 2, 3, and 4 About Here

DISCUSSION

Preliminary findings indicated that training in recognition of expository text structure was successful in improving students' ability, as measured by the graphic organizer task. Improvement in recognition of text structure can lead to improved comprehension, as readers who identify the top-level structure of a passage recall more (Meyer, 1982). However, additional analysis suggested some important limitations on this finding. When results of the better and poorer readers in the present study were examined, improvement due to training was only found for the poorer readers. The better readers, who were average in comprehension ability according to a standardized reading test, showed no improvement due to training.

These results are somewhat parallel to the findings of Holley, Dansereau, McDonald, Garland, & Collins (1979). In their study of a similar networking strategy, subjects with low college grades improved in comprehension, but those with higher grades did not.

These findings suggest that in-depth training in graphic organizers may be superfluous for the average college student. The argument may be made that greater amounts of training might result in improvements in recognition of expository text structure. After all, the mean performance of the top quartile group in the present study was only 58.86% on the graphic organizer task, leaving much room for improvement. Yet the additional time necessary for such potential gains would raise the issue of cost and benefits. If, for example, 20 hours of instruction and practice (rather than the 10 in the present study) were necessary to obtain statistically significant improvement, would the gains be worth the effort? Or perhaps would there be other ways to spend the 20 instructional hours that might be more beneficial for the average reader? Holley and Dansereau (1984) have suggested that use of graphic organizers requires 12 to 24 hours of practice until the strategy becomes sufficiently automatic to be effective. Goetz (1984) suggested that incorporation of graphic organizer strategies in a semester-long course is necessary to overcome long-established poor study habits with this more promising technique. McKeachie, on the other hand, reviewed the research on graphic organizers to conclude "that it takes a good deal of practice before spatial strategies can be used effectively--more practice time

than I feel able to allocate" (1984, p. 302).

That is not to minimize the importance of the findings, however. Most students in college level developmental reading/study skills courses are similar to the lower ability group in the present study. This group did demonstrate important overall gains on the criterion measures of text structure recognition, summarizing, and passage comprehension. For example, the mean performance of the lower ability 10-hour training group (56%) was practically identical to the mean performance of the higher ability subjects (59%). This suggests that recognition of expository text structure can be improved through training, an important finding that should influence curriculum for college level developmental reading courses.

Another finding in the study is that the instruction did little to improve students' summarizing scores or passage comprehension. Discussion of these findings with the students' classroom instructors led to a general consensus that instruction had focused on helping students better recognize expository text structure instead of summarizing. Apparently there was little transfer of improved ability to recognize text

structure to the summarizing or multiple choice comprehension tasks. Additional attention to training and practice on these tasks may be effective in helping to make that transfer. In a graphic organizer study reported by Holley and Dansereau (1984b), increased instructional attention to detail-level comprehension resulted in improvements in that skill, while an earlier study which lacked the emphasis had resulted only in improvement in main idea comprehension. Apparently instructors must clearly target instructional goals, rather than hope for automatic transfer from training in graphic organizers.

Table 1
Mean Results (and Standard Deviations) in Percent by Training Group

	Group One[a]	Group Two[b]
Graphic Organizer	58.93 (14.00)	46.06 (17.54)
Summarizing	28.86 (24.04)	31.58 (21.34)
Multiple Choice	70.69 (14.38)	67.74 (22.17)

[a] n = 29
[b] n = 31

Table 2

Mean Results (and Standard Deviations) in Percent by Training and Ability Group

	High Ability		Low Ability	
Training Group	One[a]	Two[b]	One[c]	Two[d]
Graphic Organizer	60.20	58.20	56.00	33.13
	(7.10)	(5.02)	(6.70)	(5.80)
Summary	34.40	43.00	19.66	15.50
	(9.44)	(6.68)	(7.34)	(6.36)
Passage Comprehension	76.00	79.00	63.33	48.75
	(6.81)	(4.81)	(7.66)	(6.63)

[a] n = 5
[b] n = 10
[c] n = 6
[d] n = 8

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Appendix A. Posttest passage.

Mixtures

A mixture is a combination of two or more substances that will mix but do not chemically combine. Sand and gravel is an example of this. Both substances can be mixed together but each one remains the same. The mixture does not change the properties of the sand or the gravel. Substances in a mixture can be separated by either mechanical means, as a sand and gravel mixture can be separated with a sieve, or by a physical change. Salt and water will form a mixture and can be separated by causing a physical change in the water. If the water is heated so that it changes from a liquid to a gas, the salt is left behind. This is an example of separation by physical change.

Mixtures are placed into two categories, solutions and suspensions. Solutions are mixtures that are uniform. This means that all of the substances mix evenly. Th substances still keep their unique properties but their particles are so small that the individual substance cannot be seen. Solutions can be a solid dissolved in a liquid, a liquid dissolved in a liquid, or a gas dissolved in a liquid. Th most common liquid in solutions

is water. Water is called a solvent because it dissolves other substances. The substances that are dissolved are called solutes. In a mixture of sugar and water the water is the solvent and the sugar is the solute. Examples of liquid-liquid solutions are lemon juice in water or the water-alcohol mixture in antifreeze. Carbonated drinks are examples of a gas dissolved in a liquid. The gas is carbon dioxide and that is what makes soda fizz.

The second category of mixtures is suspensions. In a suspension the particles are scattered among each other but do not dissolve. An example of a suspension is oil and water. Oil and water will mix if vigorously shaken, but if left alone they will quickly separate. Suspensions, like solutions, can be made by a solid-liquid mixture, a liquid-liquid mixture, and a gas-liquid mixture. If you mix sand and water together they will form a suspension when stirred. Shaving cream is an example of a gas-liquid suspension. The gas, in this case, is suspended in a liquid cream. If allowed to stand for a while, the gas will leave the cream and the cream will go flat.

In some suspensions, the particles cannot be easily separated. Colloids are examples of this. Colloids may look like solutions but the particles in a colloid are much larger than those in a solution. Milk is a

colloid of proteins, sugars, fats and water.

Emulsions are another type of syspension whose particles are not easily separated. Mayonnaise is an example of an emulsion. Mayonnaise is a suspension of oil, egg yolk and vinegar. The egg yolk works as an emulsifier--it attracts both the oil and the vinegar and holds the suspension together.

Appendix B. Sample Student Graphic Organizer

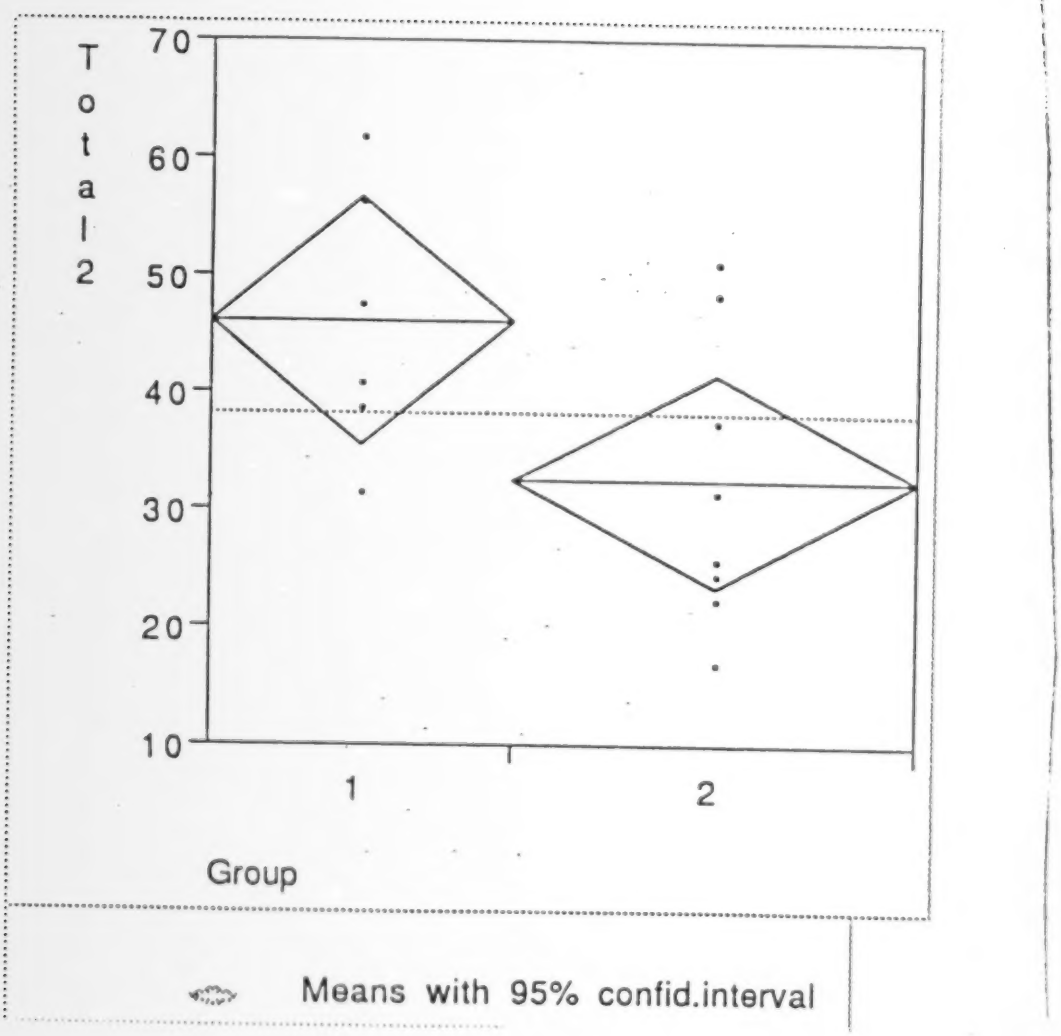

Figure 1. Total score (percentages)

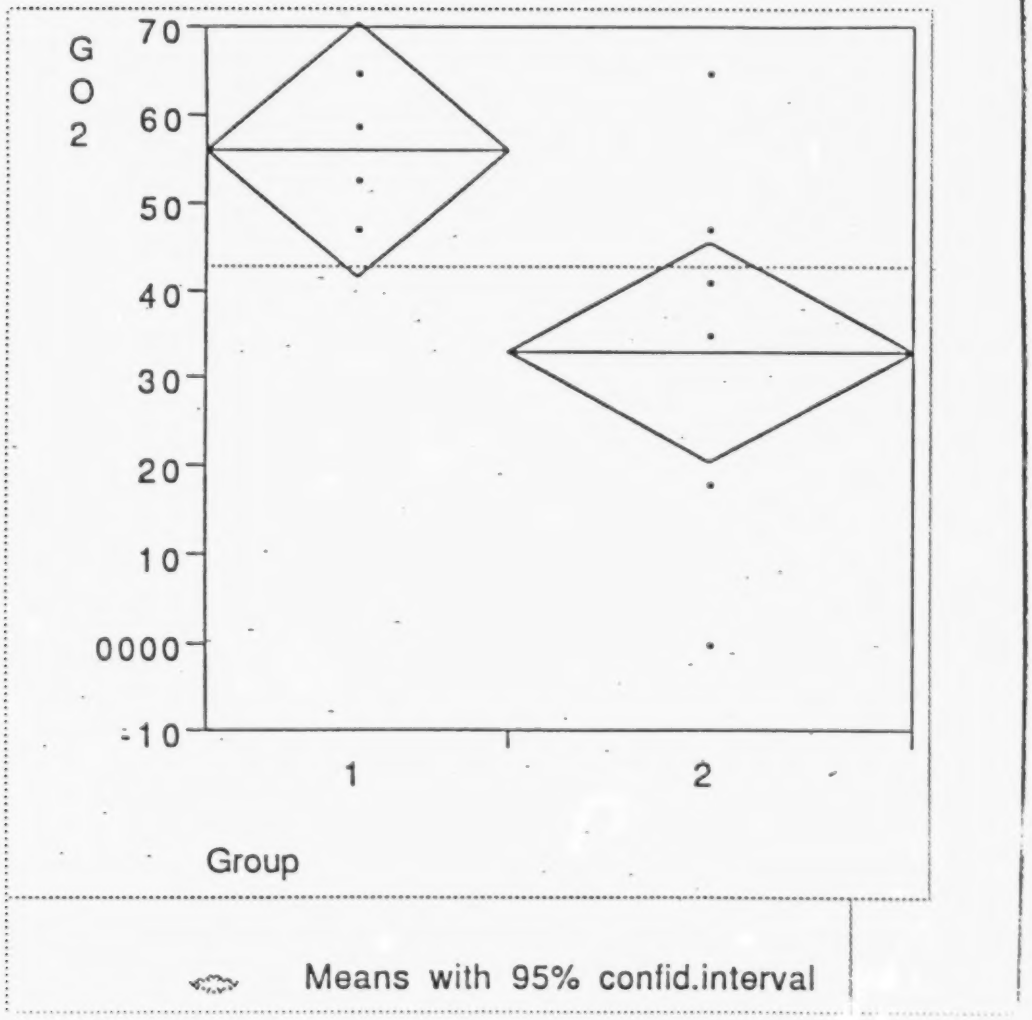

Figure 2. Graphic organizer results (percentages)

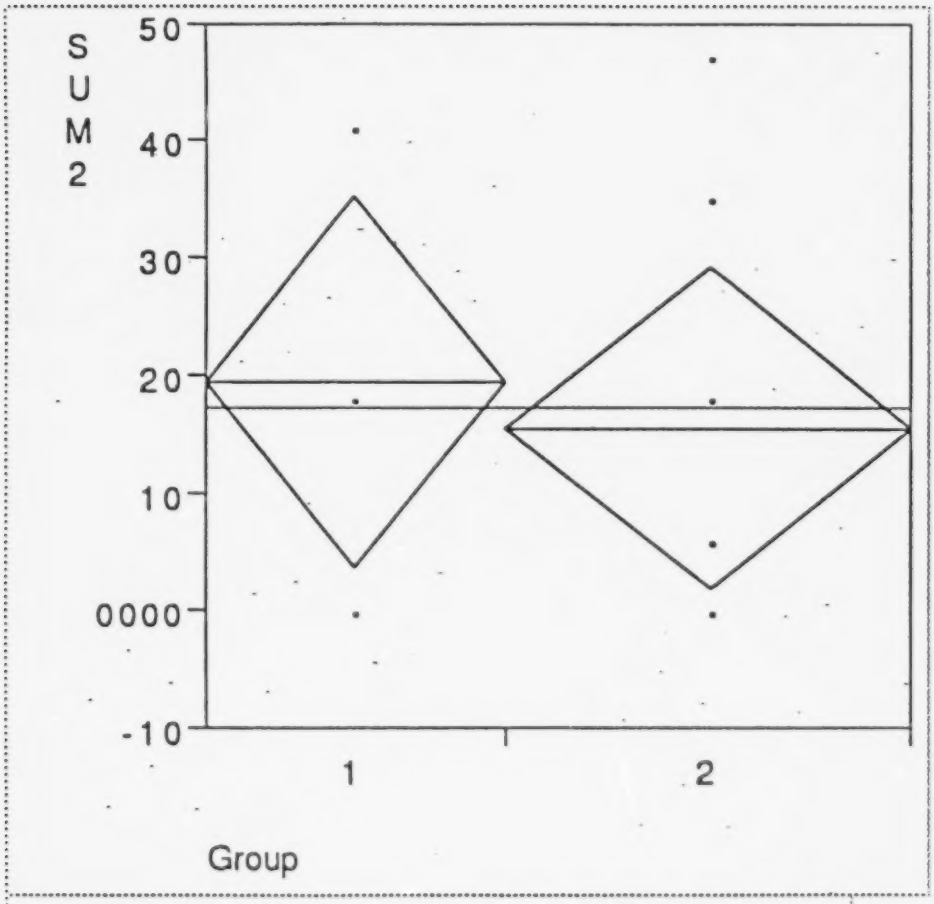

Figure 3. Summarizing results (percentages)

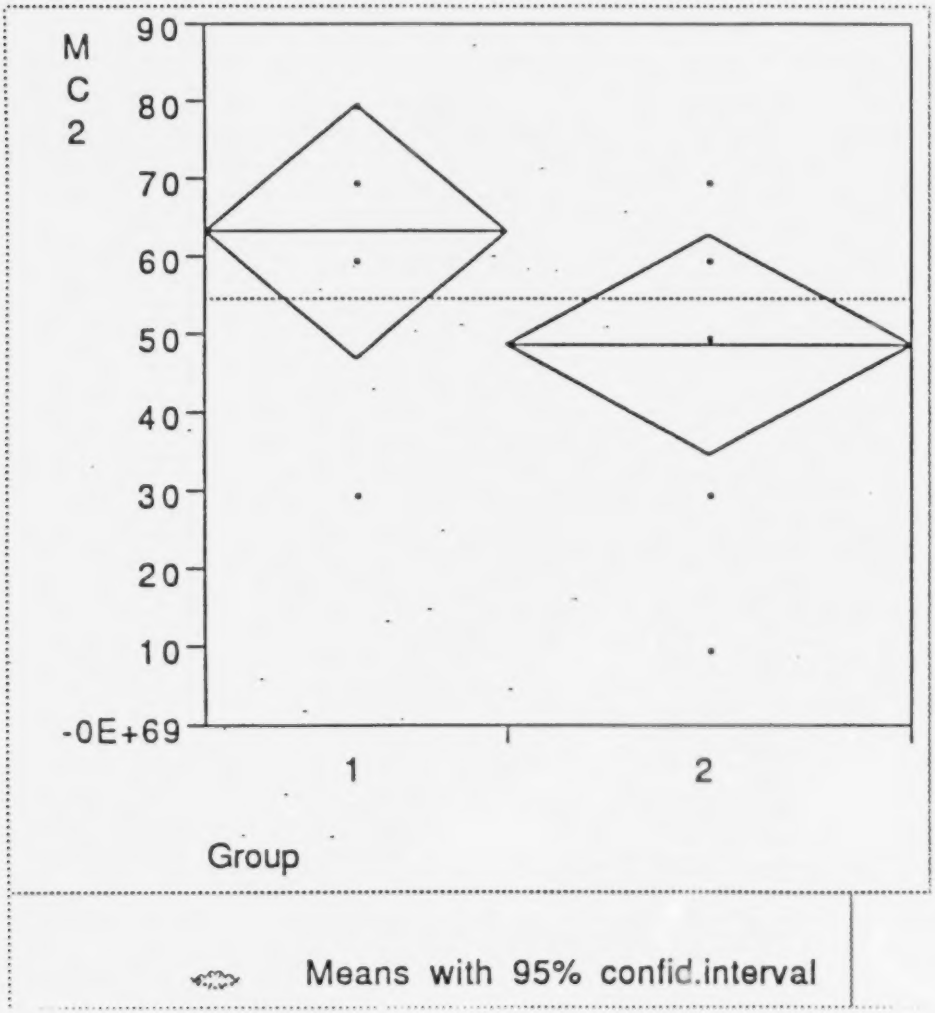

Figure 4. Passage comprehension results (percentages)